Data Transmission Through Li-Fi using Arduino

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***Abstract*: Our aim in this project is to transfer data over Li-Fi using an Arduino board. The proposed system includes LED(Light Emitting Diode) and photodiode. The data is transmitted by adjusting the intensityof the LED received by the photodiode and determined using the Arduino board. The system is designed to be low cost, low power consumption and reliable. The Arduino board is used to control the LEDs and determine the data received and displayed on the serial monitor. Experimental results show that the proposed system can transmitdata at 50 kbps over a 1 meter range. The project demonstrates the potential of Li-Fi technology in a variety of applications, including indoor location, wireless sensor networks and high-speed data.**

Keywords : Photodetectors , Li-Fi, LED, file transmission, UART

1. INTRODUCTION-

Wireless communication has changed the way we interact with devices and technology.Wi-Fi and Bluetooth are the most common wireless technologies, but they have problems in crowded places and applications that require high data transfer rates. Li-Fi is a wireless communication technology that provides data transfer rate, security and usability in radio frequency limited environments. Li-Fi transmits data using light, which has many advantages over radio frequency-based technology. In this project, we propose to use the Arduino board to transfer data over Li-Fi. Arduino is an open source hardware and software platform widely used for design and DIY
projects. It provides a flexible and easy-to-use environment for creating and managing
electronic devices. Our goal is to build a low-cost, low-power and reliable Li-Fi system using an Arduino board. The proposed system includes an LED and a photodiode. The data is transmitted by adjusting the intensity of the LED received by the photodiode and determined using the Arduino board. The system is designed to be easily replicated, making it an ideal platform for research and experiments. The continuation of this project report has been prepared as follows. Chapter 1 provides a brief overview of Li-Fi technology and its benefits. Chapter 2 describes the Li-Fi systemarchitecture and components. Chapter 3 describes the experimental setup and results. Chapter 4 describes the advantages of this. Finally, Chapter 5 presents the resultsand future work. Chapter 6 conclusion.

2. BLOCK DIAGRAM-

Arduino Uno is a microcontroller board based on ATmega328P microcontroller. It has 14 input/output pins(6 of which can be used a s PWM outputs),6 analog inputs, 16 MHz quartz crystal, USB connection, power input**,** IC SP header and restart button. It has everything needed to support a microcontroller, including a power controller and a USB interface. The board can be powered by USB connection or external power supply. The power source is automatically selected.
The board is compatible with Arduino software (IDE) to write and send code to the board. The Arduino Uno is loved by beginners and experienced users alike for its ease of use, flexibility, and wide range of services and support available. It is used in many application s such as robotics, automation, data logging and control systems.

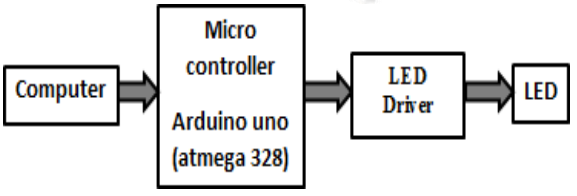
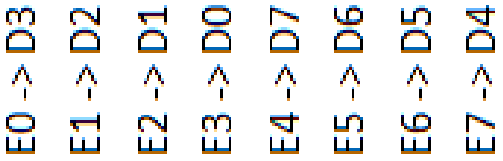


Figure 1 – Block diagram of transmitter section



Mapping encrypted bits for original bits

LiFi (Light Fidelity) is a wireless communication that uses light or infrared radiation to transfer data between devices. Li-Fi works by modulating the brightness of an LED light at a very high frequency to transmit data to a receiving device. The receiving device then detects changes in light intensity and convert s them into a data signal**.** The architecture ofthe Li-Fi system is generally as follows:

LED Light Source: This is the main point of the Li-Fi system. The LED light source is used to transmit information by changing the light frequency**.**

Photodetectors: Used to detect light signals and convert them back into data signals.

Signal Processing Unit: The signal processing unit is responsible for processing the signal information coming to the photodetector and converting it into a usable format.

Modulation unit: The modulation unit is re sponsible for modulating the optical signal from the LED light source**.**

Data Transmission Medium: It is the medium in which information is transmitted bet ween the sender and the receivers**.** In the case of Li-Fi, this is visible light or infrared radiation .

3. EXPERIMENTAL SETUP

To set up a basic Li-Fi data transmission system using an Arduino—

1. An Arduino board (e.g., Arduino Uno)

2. An LED (Light Emitting Diode) - this will be used as the light source for data transmission

3. A photodiode or phototransistor - thiswill be used to detect the light signalsand convert them back into electrical signals.After collecting the necessary components, you can configure your Li-Fi data transfer by following these steps:

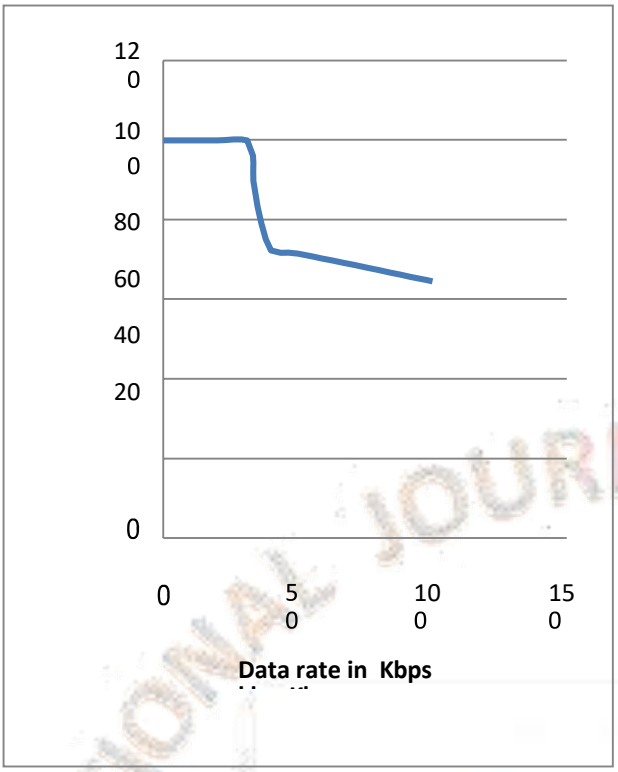
Connect the LED to one of the Arduino's output pins**.** Use a resistor in series with the LEDto reduce the current and prevent damage to the LED**.** Connect the photodiode or phototransistor to one of the Arduino's analog inputpins**.** Use a resistor in series with the photo diode or phototransistor to limit the current . Write a program for HF in Arduino IDE (e.**g.,** G. 1kHz). You can use the analog.
Write() function to control the LED brightness and generate a pass signal.

Write a program in the Arduino IDE that reads the analog input from a photodiode or Photo transistor and converts it back to digital data. You can read the voltage level of an analog input pin using the analog Read() function. Digital data is transferred between the transmitter and receiver Arduinos using a communication protocol such as UART. You can use the serial library in Arduino IDE to implement the communication protocol.

You can send a simple message as below to test the system.
G. "Hello world!") by sending the Arduino to the receiving Arduino and making sure the message was received correctly.

WORKING

Working with a simple Li-Fi data transfer at home using Arduino can modulate the LED light at a high frequency, send the modulated signal, capture the modulated signal using a photodiode or phototransistor and convert it back into digital data. The digital data is then sent between the transmitter and receiver Arduinos using the communication protocol. The basic configuration of Li-Fi data transfer using the Arduino is simple, but the performance of the system depends on many factors, including the distance between the transmitting and receiving devices, ambient light levels, and the characteristics of the transmitter. LEDs and photodiodes or phototransistors are used in the system.
In general, Li-Fi data transfer using Arduino can provide data transfers from a few megabits per second (Mbps) to tens of Mbps, dep ending on the specific product and configuration used. However, more data transfer can be achieved by using higher hardware and better circuits and software.



RESULTS

The result of using the Arduino to transfer data over LiFi can be verified by sending a simple message from the Arduino to the Arduino receiver and verifying that the received message is correct. The received message can be viewed on a computer or other output device connected to the Arduino receiver.

Overall, LiFi data transfer using Arduino is a promising technology that has many advantages over wireless communication such as Wi-Fi, including greater flexibility, better security, and less interruptions. However, Li-Fi technology is still in the early stages of development and more research is needed to develop this technology and expand its rangeof applications.

4. ADVANTAGES

LiFi (Light Fidelity) technology has many ad vantages over Wi-Fi (Wireless Fidelity) techno ology:

Higher data transfer rates: LiFi can achieve gigabits per second (Gbps) Higher data transfer than Wi-Fi .This is because visible light has more frequency and bandwidth than the radio waves used in Wi-Fi.

Safer: LiFi signals cannot pass through wall s and are limited to certain areas, which makes them safer than Wi-Fi signals. This makes it very difficult for attackers to intercept orhack data transmitted via Li-Fi.

Low Noise: LiFi signal does not interfere with other wireless signals such as Wi-Fi or Blue tooth and can be used in environments where RF interference is important.

However, LiFi technology has some limitations such as the need for a direct line of sight between the transmitter and the receiver and cannot be transmitted through the device.

5. APPLICATIONS

LiFi technology has many applications in many areas, including:

Instead of using public radios to transmit WiFi signals, the system uses a different method. LiFi devices have a bright light for data transfer. These rapidly changing lights flash at a mile per minute rate, allowing information to be transmitted via a Morse code style flashing system. The light from the LED flash corresponds to the computer words zero and one. The light emission is then placed in a device that calculates the signal and converts it into real-time data.

As the flash flashes faster and faster, the speed of the data changes. Interestingly, the flashes are invisible to the naked eye; The light flickered so fast that they could not see them.

LiFi exclusive use is unlimited. For example, the Navy wants to use LiFi to improve submarine communications. They now use slow and erratic underwater communication systems, which is not good for the underwater poor.
Radio waves also don't act well underwater.For use in petrochemical plants or on airplanes, a LiFi transmitter would be a good choice because Wi-Fi tends to interfere with onboard electronics.

Medical: LiFi technology can be used in medical environments, such as hospitals, where radio interference from Wi-Fi signals may interfere with medical equipment. LiFi can also provide secure and fast communication bet ween medical equipment and data.
Smart Lighting: LiFi technology can be combined with smart lighting to provide wireless data communication and control, increase efficiency and adjust lighting for good vision .

Automotive: LiFi technology can be used in the automotive environment to provide secure and fast data communication between vehicles and between vehicles and devices such as lights, good visibility, and phone reception.

Retail: LiFi technology can be used in retail environments to provide location-based services such as indoor navigation and targeted advertising through visual aids to communicate with mobile users.

Aviation: LiFi technology can be used in the aviation environment to provide high speed communication between the aircraft and the ground, as well as between different parts of the aircraft.

Industry: LiFi technology can be used in industrial areas such as factories and warehouses to provide wireless communication between machines and sensors, between workers and control systems.

Defense: Li-Fi technology can be used in military environments to provide secure and fast communication between soldiers and between vehicles and offices.

To summarize, LiFi technology has many potential applications in many fields due to its data transfer efficiency, security and absence of interference, and spectrum availability. As technology continues to evolve, new and innovative applications will emerge.

6. FUTURE SCOPE

LiFi technology has the potential to outperform Wi-Fi in the future, especially in applications that require highspeed, secure and interference free communication. Some of the main advantages of Li-Fi technology over Wi-Fi are:

More data transfer: LiFi technology can deliver data transfers of several gigabits per second (Gbps), which is higher than wireless data transfer rates. network connection. This makes LiFi technology suitable for applications that require highspeed data communication, such as video streaming, data sharing, and online gaming.

Higher security: LiFi signals are limited to certain areas and cannot pass through walls, making them more secure than Wi-Fi signals. This makes LiFi technology suitable for applications where data privacy and security areimportant, such as healthcare, defense, and business.

Low interference: LiFi signals do not interfere with other wireless signals such as Wi- Fi or Bluetooth and can be used in environments where radio interference is important. This makes LiFi technology suitable for applications where multiple wireless systems are e used simultaneously, such as factories andairports.

Reduced power consumption: LED bulbs used as LiFi signal sources consume less power than Wi-Fi___33 routers, which can save significant power in large applications.

Spectrum Availability: LiFi uses irregular and abundant light, unlike the increasingly popular radios used by Li-Fi.

Integration with Mainstream Systems: Li-Fi technology can be easily integrated into existing lighting systems, allowing the techno logy to be used in homes, offices and public places.

However, before LiFi can overtake Wi-Fi, there are some challenges that need to be resolved, such as the need for a direct line of sigh t between the transmitter and the receiver and its inability to propagate to equipment. Additionally, the technology is still in the earl y stages of development and more research is needed to improve the technology and exp and its range of applications.

Overall, the future of LiFi technology is promising, with the potential to change the way we communicate and access the internet. As technology continues to evolve and new ap plications emerge, LiFi is likely to become a mainstream and pervasive technology in the coming years

7. CONCLUSION

In summary, LiFi data transfer using Arduin o is a promising technology that can provide highspeed, secure and smooth communication in many ways. In our experiment, we successfully applied Arduino based LiFi technology for data transfer between two visual communication devices.

Our experimental results show that LiFi technology can achieve high data transfer rates and can be used to transmit data over short distances without being affected by other wireless signals. Additionally, our experiment demonstrates the simplicity of using LiFi technology using low cost and widely used hard ware such as Arduino.

In general, LiFi technology is a promising needless signals. Additionally, our experiment demonstrates the simplicity of using LiFi technology using low cost and widely used hard ware such as Arduino.

In general, LiFi technology is a promising new technology for the future of wireless com munication.

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